Generation Forecasting Of A PV Power Plant In Odisha

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Abstract: With the worldwide energy crisis and therefore the more and more serious environmental issues, renewable energy becomes a future energy trends. PV energy can be used as major alternative energy resources due to its low maintenance cost as well as operational value. Even by considering the atmospherical effects which may hamper the efficiency of a PV cell, still we can draw many advantages from PV source. This paper unveil the case study of a solar PV plant which includes performance evaluation and energy forecasting respective of various losses occurs due to effect of temperature, effect of shading, effect of dust etc. The real time performance result of the plant is compared with a developed MATLAB simulink PV model as well as the result obtained from PVSYST Software. Error percentage is calculated from the obtained results by MAPE(Mean Absolute Percentage Error) method in order to validate the real time power plant data.

Index Term: Renewable energy Sources, PV Power Plant, Energy Generation, Performance evaluation, PVSYST Software

1 INTRODUCTION

Electricity is the primary source of energy in the city. Power is primarily utilized for lighting, cooling, warming and driving residential, business, mechanical and metropolitan. The information for power utilization is gathered for a time of eight years for every one of the divisions to know the pattern of power utilization in the city [2]. In commercial sectors likewise, power is the principle source of vitality for controlling the electrical types of gear. There are relatively few enterprises in Bhubaneswar city which use power for their everyday activities except it is utilized in a portion of the basic businesses. In municipal sector, power is being utilized for arrangement metro administrations of the city body like road lighting, water supply, sewage treatment plant and enlightenment of places of business of the metropolitan partnership. The financial feasibility of the sun powered PV systems relies upon the system establishment cost, the output of the plant, accessibility of the land, public awareness, and government arrangements [3]. The energy generation of a PV plant relies upon the climatic conditions, which are erratic, for the area[5]. In this manner, the forecast of the output of proposed PV plant for a present moment (for multi day) and long haul (for month and year) in advance proves to be useful for the proprietors and organizers. The total solar power commissioned by 2015 is 150GW as per[6]. The average radiation, temperature, array generation, inverter output are required to be taken in to consideration [9]

2 DESCRIPTION OF THE PV POWER PLANT

The power plant named S.N.Mohanty solar is having a capacity of generating 1 MW energy which was established at village Patapur, Trishulia in the district of Cuttack in the year 2011 under Jawaharlal Nehru National Solar Mission (JNNSM). Which is receiving a good average solar radiation of 2.27kW/m^2/day and annual average temperature of about 27.3 degrees centigrade.

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Plant is south east faced having a tilt angle 20degree. The PV plant is a grid tied plant consisting of around 4400 panel each panels of rating 230Wp. The PV panels are arranged in series parallel manner out of which 22 strings are in series and the rest are in parallel. The string voltage is 636 Volt. The plant operates with 2 three phase IGBT based inverters of rating 500kW. The inverters uses LCL filter which is attached externally. The output from the inverter is fed to a 1250Kva transformer which is a part of the ring main unit. The output from the transformer is fully supplied to an 11kV grid.

3 PROPOSED METHOD

The proposed performance evaluation method comprises of 3 steps:

i. Manual extraction of solar power plant data from the SCADA system
ii. Comparison of performance with the results obtained from designed PV MATLAB model
iii. Comparison of performance with the results from PVSYST software

Fig 1: Plant layout OF S.N.Mohanty Power Plant

4 DESIGNED MATLAB MODEL OF PV CELL

One can arrange PV arrays with the assistance of series and parallel mix of solar cells. A perfect Solar cell is demonstrated by a current source in parallel with a diode. The assessed output of the model is free of some other impacting factors aside from three input parameters: Annual incident global

radiation, Annual Average air temperature, and temperature coefficient of the module. Model converts air temperature to differential modutemperature characterized as the capacity of the normal air temperature and incident radiation.

***Table 1**: Rating and specification of parameters used in the proposed model*

PARAMETERS	RATING
N_s	60
N_p	5
V_{oc}	41.79 V
I_{sc}	7.13 Amp
V_{mpp}	33.9 V
I_{mpp}	6.63 Amp
R_s	0.02 Ohm
I_{ph}	7.145 Amp
T_r	25^{oC}
S	1000 w/cm2
I_D	0.002
I_{sat}	$3.149e^{-8}$

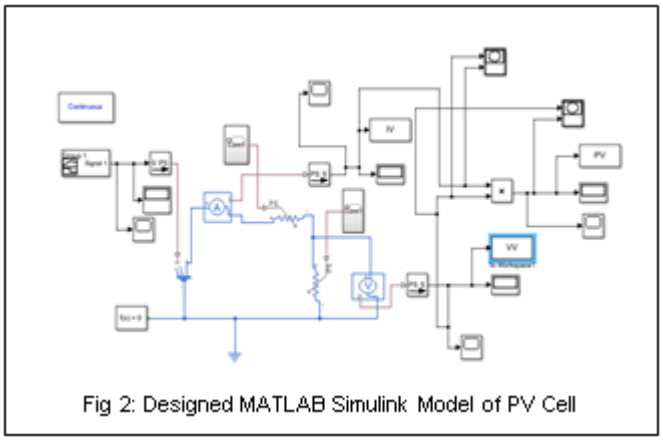

Fig 2: Designed MATLAB Simulink Model of PV Cell

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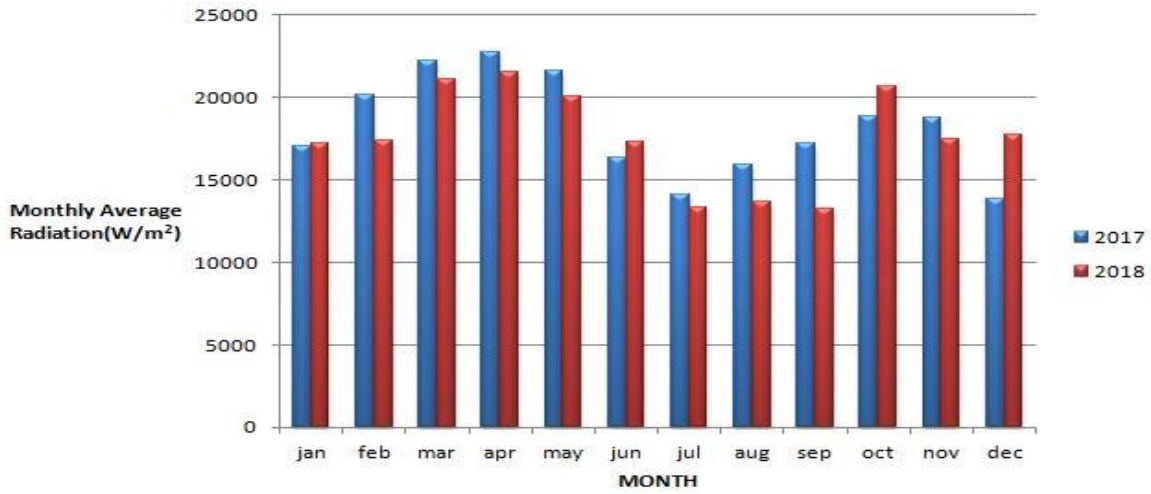
In figure 2 the proposed MATLAB model is shown and in table 1 the detailed rating and specification of parameters is given. From that model using the parameters the total yearly average generation is calculated. Then the obtained result is compared with the existing plant generation. Again from PVSYST software the plant generation is calculated. Here we have to input the geographical location of the plant i.e., the longitude and latitude of that location as well as the detailed parameters such as radiation, module temperature, ambient temperature etc. are included for the simulation in the software in order to obtain the result. The obtained result is compared with both the actual plant generation as well as with the output obtained from designed MATLAB model. Comparing plant generation with output obtained from MATLAB model and PVSYST software error percentage is calculated by MAPE method by using the following equation,

Where, A= Actual
F= Forecast
N= number of observation

$$MAPE = \frac{\sum \frac{|A-F|}{A} \times 100}{N} \quad \text{..... (1)}$$

***Table 2**: average monthly irradiation for year 2017 and 2018*

MONTH/YEAR	2017	2018
	Monthly Average Radiation	Monthly Average Radiation
January	17035.27	17212.32
February	20164.18	17400.04
March	22186.67	21081.34
April	22738.99	21539.94
May	21649.81	20033.66
June	16330.96	17282.55
July	14099.44	13303.68
August	15880.52	13694.37
September	17249.86	13235.62
October	18834.27	20664.35
November	18767.62	17490.47
December	13810.14	17719.92



Graph 1: *Average monthly irradiation for the year 2017 and 2018*

YEAR	Actual Generation from the Plant(MWh)	Generation obtained from Designed Model(MWh)	Calculated generation from PVSYST Software	Percentage error	
				Designed model output	Software output
2017	1.273	1.212	1.268	4.79	0.39
2018	1.201	1.186	1.193	1.24	0.67

Table 3*: Comparison result of forecasted data with actual data*

6 CONCLUSION

This paper unveil the performance study of 1 MW grid connected solar photovoltaic power plant on annual basis. A peak power output of 1.34 MW and 10.83 kW of minimum power output were observed during the year round operation. Maximum total energy generation of 1406kWh was observed in the month of January and lowest total energy generation of 750.228kWh was observed in the month of July. By comparing the results obtained from designed PV model and from PVSYST software we can conclude that, though the designed model gave nearly approximate output as of plant but the output obtained from PVSYST software gives more accurate result.

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